The Freshwater Trust®

September 9, 2016

Lower Boise River Total Phosphorus Baseline

Evaluation of Baseline Options for Water Quality Trading

Introduction

Trading baseline for non-point source projects establishes a minimum level of effort, pollutant reduction, or level of implementation that must be achieved before a project is eligible to generate tradable credits. Trading baseline is included in frameworks and permit trading plans to ensure that credit projects generate environmental benefits beyond those activities already required by law and in the context of a TMDL, pollutant reductions already expected in TMDL implementation plans. In a trading framework, baseline must be scientifically grounded and consistent with federal and state regulations, and must contribute to the achievement of water quality goals established for a geographic area (in a TMDL or otherwise). One approach to expressing baseline is to define an environmental performance threshold that a project must achieve.[1] Such a performance based method for expressing baseline should be technically feasible and relatively easy to implement at the project level, and related to other conservation factors included in a framework (e.g., ratios, credit life). In order to facilitate the development of a recommended approach to baseline that strikes this balance, The Freshwater Trust (The Trust) has conducted an "as applied" assessment of two proposed nonpoint source baseline methodologies. These two approaches for nonpoint source baseline obligations in the Lower Boise were proposed by EPA Region 10 with the goal of formulating obligations that could be reasonably derived[2] from Lower Boise River total phosphorus (TP) Total Maximum Daily Load (TMDL) load allocations (LA),[3] and easily applied to individual field-scale credit generating projects.

The two methodologies proposed by EPA seek to accomplish this goal. Both proposals start by quantifying the amount of TP reductions required for each tributary within the proposed trading area to achieve the TMDL's target concentrations.[4] From there the proposals diverge, using differing methods to derive field-level baseline obligations. The first proposal, option A, would proportionally set a baseline obligation to each field based on its relative contribution to overall load.[5] Option B, on the other hand, applies the needed TP load reduction evenly

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[1] For additional options and considerations for expressing baseline see *Building a Water Quality Trading Program: Options and Considerations* a publication of the National Network on Water Quality Trading, *available at* http://nnwqt.org/products.

[2] U.S. EPA, Water Quality Trading Toolkit for Permit Writers, 29, EPA 833-R-07-004 (Aug. 2007, updated June 2009), *available at* http://www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf ("For a nonpoint source seller in a watershed under a TMDL, the source's baseline would be derived from the nonpoint source's [Load Allocation]").

[3] Idaho Dep't of Envtl. Quality, Lower Boise River TMDL: Final 2015 Total Phosphorus Addendum, at § 5 (Aug. 2015), *available at* http://www.deq.idaho.gov/media/60177413/lower-boise-river-tmdl-total-phosphorus-addendum-0815.pdf. *See* Table 1 for the current loading and assigned load allocations.

[4] As currently proposed, the trading area is consistent with the area outlined in the 2015 Total Phosphorus TMDL Addendum and does not include Sand Hollow Creek.

[5] Option A is a proportion-based approach that requires collecting field specific information to model the current sediment runoff from each field based on current cropping patterns as well as land and water management. That runoff is then converted into a corresponding amount of modeled TP loading from the field. This field level loading estimate is then compared to the overall TP reduction need for a tributary, which enables a calculation of the percentage of the tributary's TP loading attributable to that field. The tributary's overall required TP reduction, represented as a percent, is then applied to the loading from each field, resulting in the amount of TP reductions the individual field needs to realize in order to achieve the LA and thus the baseline.

by acre of farmland in a geographic reach.[6] Both approaches ensure that there is a nexus between the baseline for every credit generating field and the TMDL LAs, though the means used to achieve this end differ.

The Trust applied the two options at two geographic scales: to Mason Creek[7]—a tributary without point sources where the true impacts of nonpoint source TP loading could be well understood—and the overall Lower Boise River watershed, which provides an understanding of how all of the tributaries interact and relate to the overall TMDL goals. This memorandum provides a more in-depth description of the approaches and identifies the notable strengths and weaknesses of both. This analysis serves to provide stakeholders and regulators with the ability to adopt a reasonable baseline methodology as part of the Lower Boise River water quality trading framework refresh.

Approach

The following sections work through the details of the proposed options for calculating baseline in order to provide a comprehensive understanding of the methods employed for each.

STEP 1: CALCULATE NECESSARY LOAD REDUCTION

Step 1 compares the nonpoint source total phosphorus load allocation and the current nonpoint source total phosphorus loading identified in the Lower Boise River Total Phosphorus TMDL in order to calculate the load reduction necessary to achieve the target load allocations.[8] For Mason Creek, The Trust calculated the current TP load delivered to the Lower Boise River from May 1 to September 30—the "irrigation season" period established by the TMDL[9]—by multiplying the current load, 322.1 lb/day, by the 152 days in that period. The result indicates that Mason Creek delivers 48,959 lbs of TP to the Lower Boise River from May 1 to September 30. The TMDL TP target concentration for Mason Creek is 0.07 mg/L, which represents a monthly average load allocation of 56.1 lb/day, or a seasonal load of 8,527 lbs of TP from May 1 to September 30. Taken together, the load reduction necessary to meet the May 1 to September 30 TP load allocation for Mason creek from all nonpoint sources in the subwatershed would be 40,432 lbs (Table 1).

The Trust performed the same calculations to determine the TP load delivered from all Lower Boise tributaries, as outlined in the Lower Boise River Total Phosphorus TMDL.[10] These calculations and the resulting information presented here do not include Sand Hollow Creek, which is consistent with the 2015 Lower Boise River Total Phosphorus TMDL Addendum. To calculate the current TP load delivered by all tributaries from May 1 to September 30, The Trust multiplied the current load, 1,664.4 lb/day, by the 152 day period. The resulting loading information indicates that all of the tributaries deliver 252,989 lbs of TP to the Lower Boise River between May 1 and September 30. The TMDL's TP target concentrations for the tributaries range from 0.07 to 0.89 mg/L. When this target concentration is expressed as a monthly average load allocation from all tributaries, the total load is 356.7 lb/day, or 54,218 lbs of TP from May 1 to September 30. In order to meet the May 1 to September 30 load allocation, the total TP load from all nonpoint sources in all of the contributing tributaries would need to be reduced by 198,770 lbs (Table 1).

[6] The Trust used mapping technology to quantify the amount of farm acreage in each subbasin. The baseline is then calculated by dividing the required TP reductions by the number of irrigated acres, yielding a per acre TP reduction required for each drain or tributary in the Lower Boise subbasin.
[7] It should be noted that Mason Creek has the highest contribution of all the tributaries. This is worthwhile to note when contemplating the difference between the tributary and subwatershed scales.
[8] Idaho Dep't of Envtl. Quality, Lower Boise River TMDL: Final 2015 Total Phosphorus Addendum, at § 5.4.1.4, Table 30 (Aug. 2015).
[9] *Id.* at § 5.
[10] *Id.* at § 5.4.1.4.

Table 1. Current nonpoint source total phosphorus loading and nonpoint source total phosphorus load allocation from the Lower Boise River Total Phosphorus TMDL for May 1 to September 30[11].

Tributary	Current TP Load (lb/day)*	Current TP Load (lb/season)	Average TP Allocation (lb/day)**	Average TP Allocation (lb/season)	Needed TP Load Reduction (lb/season)
Mason Creek	322.1	48,959	56.1	8,527	***40,432***
All Tributaries	1,664.4	252,989	356.7	54,218	***198,770***

* *Values from Table 30 on page 101 of the TMDL.*

** *Allocation as a monthly average. Values from Table 30 on page 101 of the TMDL.*

STEP 2: CALCULATE BASELINE OBLIGATION

The necessary TP load reductions calculated in Step 1 represent the reductions eventually required in order to meet the TMDL load allocations for tributary nonpoint sources. In Step 2, baseline obligations are derived from the phosphorus load reductions necessary to meet the nonpoint source load allocations. EPA has proposed two calculation methods to translate these load reductions into individual baseline obligations, referred to here as Options A and B. The following two sections explain these methods and convey the results of their respective applications to the Lower Boise River.

Option A: Proportional distribution of required load reduction by current load contribution

Option A sets a proportional baseline obligation for each field by comparing an individual field's TP loading to the total loading from that tributary or subwatershed. More specifically, this calculation method uses field-scale SISL modeling[12] to derive an individual field's phosphorus contribution to the waterway. The modeled contribution is based on the physical characteristics of an individual field, including the slope, soil type, acreage, and observed crop types. A field's individual load contribution is then compared to the total load from the tributary of interest. This yields the percent of the tributary's phosphorus load that a given field is currently responsible for. Using this option, a field's proportional share of the current load is then used to calculate its share of the load reduction necessary (calculated in Step 1) to meet the tributary LA, establishing a baseline obligation for each individual field.

To better understand how this approach might apply in practice, The Trust modeled the current TP load from each individual field within the Lower Boise River subbasin using the Surface Irrigation Soil Loss (SISL) model and available geospatial data.[13] Under Option A, each field's baseline obligation is proportional to its contribution to the overall load. The proportional allocation is translated to a field-specific baseline obligation by multiplying the proportional share of current watershed loading by the load reduction necessary to meet the load allocation calculated in Step 1. As a result, each field within the basin will have a different baseline obligation. For example,

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[11] Seasonal loads are calculated by multiplying by the 152 day time period

[12] SISL is the "surface irrigation soil loss" model, which is an empirically-based "edge-of-field" sediment loss model. The Idaho Natural Resources Conservation Services (NRCS) developed the SISL model to estimate annual soil loss from surface irrigated fields in Southwestern Idaho (NRCS, 2003). The SISL model is an empirical model that was developed by the NRCS using over 200 field-years of data from southern Idaho. The form of the SISL model is similar to that of the Universal Soil Loss Equation (USLE). SISL relies on base soil type, soil erosion, crop type, conservation practice and irrigation management factors to calculate the surface irrigation induced sediment erosion that leaves the end of the field.

[13] The modeling approach, including data sources, assumptions, and results, are included in an analysis of the watershed. *See* The Freshwater Trust, Lower Boise River Technical Analysis (July 2015), *available at* http://www.deq.idaho.gov/media/60178406/lower-boise-river-technical-analysis-freshwater-trust-0516.pdf.

if an agricultural field's modeled current TP contribution represents 0.5% of the overall modeled total load from Mason Creek, its share of the load reduction necessary to meet the tributary's load allocation would also be 0.5%. Using the necessary load reduction for Mason Creek, this hypothetical field's baseline obligation would be 0.5% of 40,432 lbs, or 202.16 lbs. If this hypothetical field were 50 acres, this would translate to a baseline obligation of 4.04 lbs/acre.

As with Step 1, The Trust applied the method to the fields within the Mason Creek subwatershed (Figure 1).

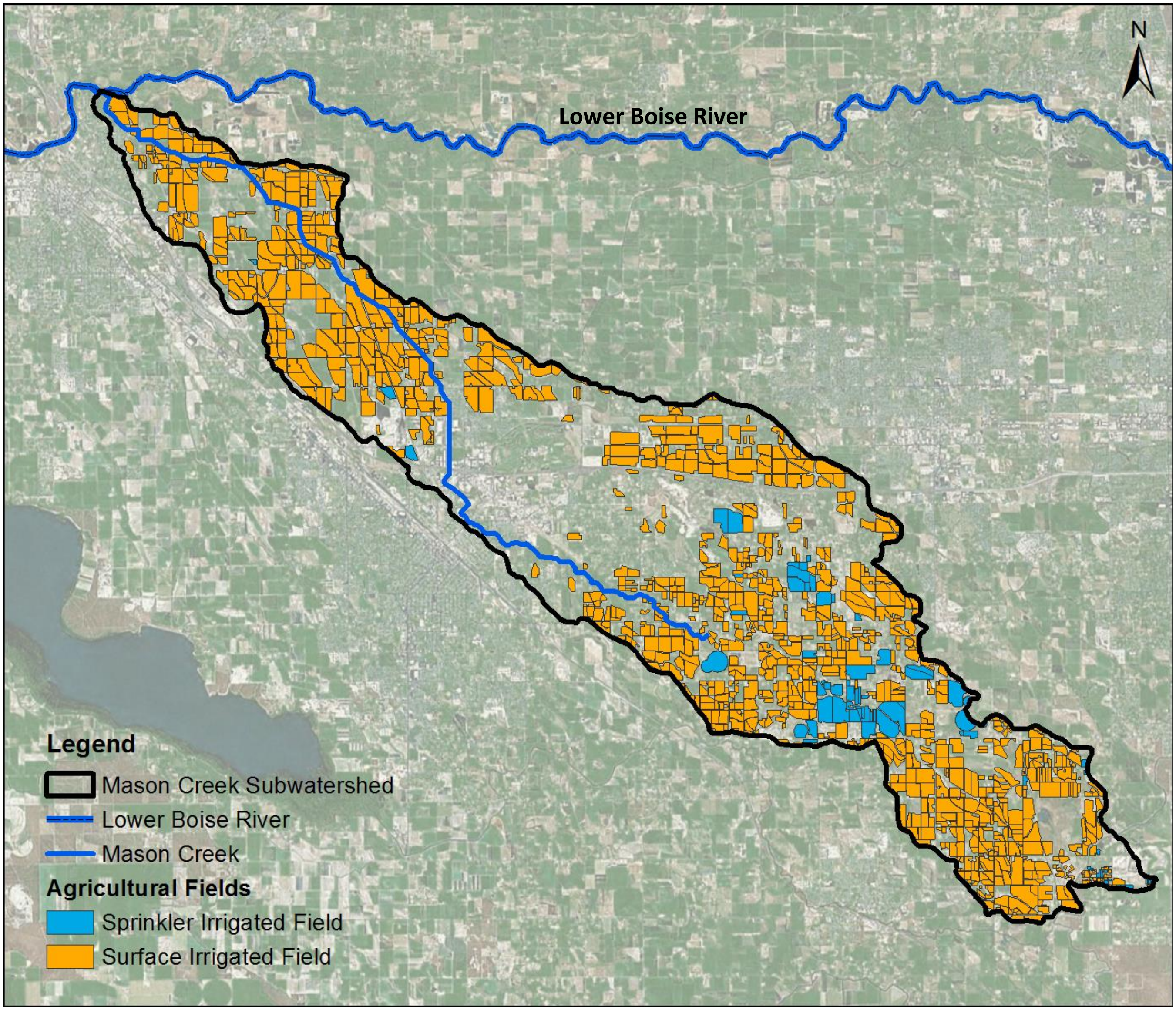

Figure 1. Agricultural fields within the Mason Creek subwatershed that were included in the analysis.

The Trust also applied the method to all of the fields in the Lower Boise River subbasin (Figure 2).

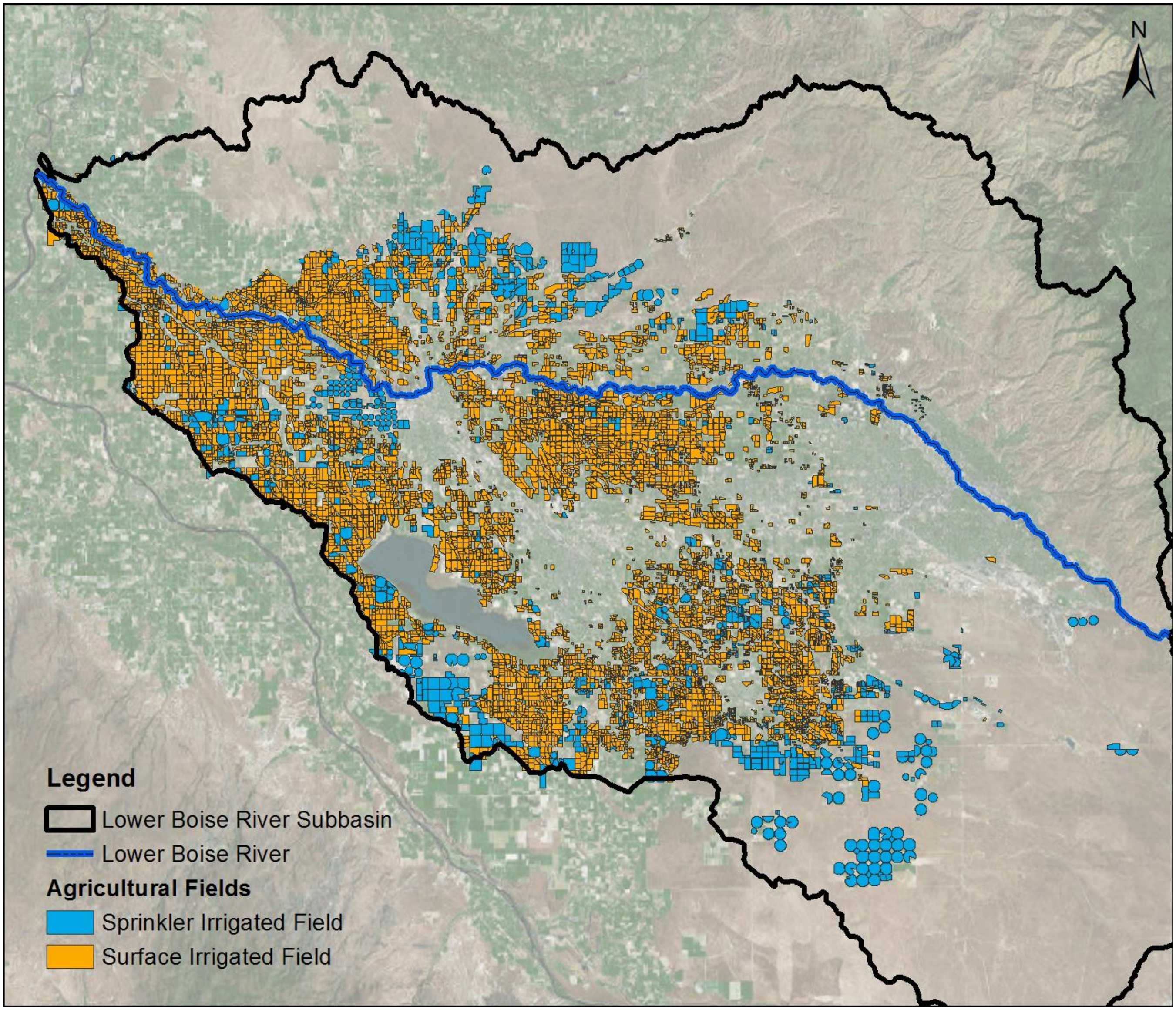

Figure 2. Agricultural fields within the Lower Boise River subbasin included in the analysis.

Applying the proportional distribution method to all of the fields within the Mason Creek subwatershed results in a mean baseline obligation of 2.35 lb/acre, with baselines ranging from 0 to 22.06 lb/acre (Table 3). Across the entire subbasin, the mean share of the required 198,770 lb reduction is 0.93 lb/acre, ranging from 0 to 8.40 lb/acre (Table 3). While the mean is useful for understanding the general characteristics of the basin, each individual field would have a unique baseline obligation.

Table 2. Total phosphorus baseline obligation results using Option A.

	Baseline TP Load Reduction All Fields		
Tributary	**Mean (lb/ac)**	**Min (lb/ac)**	**Max (lb/ac)**
Mason Creek	2.35	0.00	22.06
All Tributaries	0.93	0.00	8.40

Option A is field specific and, as such, it may be necessary to exclude fields that likely do not contribute a large amount of phosphorus. This mainly applies to sprinkler irrigated fields, as that irrigation technique significantly reduces runoff and thus surface water phosphorus inputs from runoff. Using aerial imagery, The Trust has identified many of the sprinkler irrigated agricultural fields within the Lower Boise River subbasin. To accomplish this task, The Trust visually inspected the imagery and identified the fields that had notable signs of sprinkler irrigation systems (i.e., center pivots, wheel lines, hand lines). The Trust only calculated the baseline obligation for the fields identified as not currently using sprinkler irrigation techniques. In this scenario, fewer agricultural fields are responsible for the current total phosphorus load and the necessary load reduction. As such, each field's proportional share of the necessary load would be greater (Table 3). In the Mason Creek subwatershed, this approach yields a mean baseline obligation of 2.67 lb/acre and a range of baseline obligations from 0 to 25.98 lb/acre. Across the entire subbasin, the mean share of the required 198,770 lb reduction is 1.46 lb/acre, ranging from 0 to 13.55 lb/acre.

Table 3. Total phosphorus baseline obligations from Option A, with sprinkler irrigated fields removed from the available acreage.

	Baseline TP Load Reduction Surface Irrigated Fields		
Tributary	**Mean (lb/ac)**	**Min (lb/ac)**	**Max (lb/ac)**
Mason Creek	2.67	0.00	25.98
All Tributaries	1.46	0.00	13.55

Option B: Proportional distribution of required load reduction by acreage

The second baseline calculation method is a "disaggregated approach" based on total field acreage in each tributary. Essentially, this option divides the total load reduction needed to meet load allocations by the number of acres that contribute phosphorus, resulting in a per acre baseline obligation. While Option A results in different baseline obligations for each field based on the field's modeled TP load (resulting in a variable per acre baseline obligation), Option B yields the same per acre baseline obligation for all fields in the subwatershed. Using this method, each field's share of the required load reduction is based on the size of the field.

As part of an earlier modeling effort, The Trust digitized the boundaries of all irrigated fields in the Lower Boise River subbasin.[14] The heads-up digitizing was done using ArcMap (ESRI, 2012) and recent orthoimagery of the

[14] For more information, see The Freshwater Trust, Lower Boise River Technical Analysis (July 2015), *available at* http://www.deq.idaho.gov/media/60178406/lower-boise-river-technical-analysis-freshwater-trust-0516.pdf.

study area (results summarized in Table 4). To calculate each field's proportional share of the necessary load reductions, The Trust used the acreages associated with the delineated fields (Figure1 and Figure 2).

Table 4. Number of all agricultural fields and the total agricultural acreage in Mason Creek and the Lower Boise River subbasin, as well as the number of surface irrigated fields and their associated acreage.

	All Fields		Surface Irrigated Fields Only	
Tributary	**Number of Fields**	**Acres**	**Number of Fields**	**Acres**
Mason Creek	1,016	15,383	960	14,118
All Tributaries	9,065	164,415	7,990	123,064

For Mason Creek, the load reduction necessary to meet the tributary's load allocation is 40,432 lbs (see Step 1, Table 1). As illustrated in Table 5, distributing the load reduction equally across all of the 15,383 irrigated acres in the subwatershed results in a baseline obligation of 2.63 lb/acre; distributing the load reduction equally across all 14,118 acres of *surface* irrigated fields within the subwatershed generates a baseline of 2.86 lb/acre. For all tributaries in the Lower Boise River subbasin, the reduction necessary to meet the load allocation is 198,770 lbs (see Step 1, Table 1). As demonstrated in Table 5, distributing the load reduction equally across all of the 164,415 irrigated acres within the Lower Boise River subbasin produces a baseline obligation of 1.21 lb/acre; distributing the load reduction equally across all of 123,064 *surface* irrigated acres within the Lower Boise River subbasin results in a baseline obligation of 1.62 lb/acre.

Table 5. Total phosphorus baseline obligation results using Option B[15]*.*

	All Fields		Surface Irrigated Fields Only	
Tributary	**Baseline TP Reduction (lb/acre)**	**Fields with loading above baseline**	**Required TP baseline (lb/acre)**	**Fields with loading above baseline**
Mason Creek	2.63	460 (45%)*	2.86	395 (41%)
All Tributaries	1.21	6,200 (68%)*	1.62	4,982 (62%)

**These results would change if a phased baseline is adopted.*

Applying a single, uniform baseline obligation to all acres means that some fields will have an existing modeled TP contribution below the per acre baseline obligation. The 'fields with loading above baseline' columns in Table 5 illustrate how many fields would still have pounds of phosphorus to trade after applying the per acre baseline obligations. For example, using the "all tributaries" and "all fields" approach—which results in a 1.21 lb/acre baseline obligation—6,200 fields, or 68% of all fields in the Lower Boise River subbasin, would have a modeled load above 1.21 lb/acre. That means that over two-thirds of fields would have potential phosphorus reductions to trade.

[15] T The number of fields with loading above baseline represent the fields with a modeled current total phosphorus load greater than the baseline obligation

Summary & Considerations

As summarized in Step 1 of the analysis, the TMDL indicates that Mason Creek delivers 48,959 lbs. of total phosphorus to the Lower Boise River from May 1 to September 30. Based on the seasonal load allocation for Mason Creek, the total phosphorus load from nonpoint sources in that subwatershed would need to be reduced by 40,432 lbs. (Table 1). At the watershed scale, the TMDL demonstrates that all of the tributaries combined deliver 252,989 lbs. of total phosphorus to the Lower Boise River from May 1 to September 30. Based on load allocations for the contributing tributaries, in order to meet the seasonal load allocation, the total phosphorus load from all nonpoint sources would need to be reduced by 198,770 lbs (Table 1).

When considering the methodologies to calculate baseline obligations as proposed by EPA Region 10 and describe in this analysis, the first point of decision is whether to use tributary-specific data or to aggregate all information from the larger Lower Boise River subbasin. Because the point of compliance for total phosphorus loading in the TMDL is the mouth of the Lower Boise River near Parma, which aggregates all of the load from all of the tributaries, a basin-wide approach may be more aligned with the TMDL. Similarly, a basin-wide approach considers total loading from all fields, avoiding the need to trace the load from an individual field to the mouth of a tributary or to make sense of the complicated reuse dynamics that affect a number of the tributaries.

Since both options can be reasonably derived from TMDL load allocations, the second point of decision is which of the two options (A or B), as applied to the Lower Boise Trading Framework, will maximize accuracy and predictability, minimize complexity and transaction costs, help steer to the right outcomes (e.g., getting the highest impact projects implemented more quickly, allowing potential buyers to monetize and assess the cost of baseline when comparing to technological alternatives), and align with regulatory precedents in other similar contexts. The following bullets compare and contrast the two options on each of these points:

- **Accuracy & predictability**:
  Option A would establish a tailored baseline obligation for each field based on site-specific modeling, and the proportion of the total TP load that the field contributes at a specific point time. This approach would therefore provide the most accurate “share” of responsibility to a participating field. However, because the baseline obligation would be based on a site specific application of SISL, one would have to assume that performance and management choices used to model impacts at a specific site would continue into the future. Like Option A, Option B makes assumptions as to existing practices and levels of loading, but generalizes performance and management assumptions across all parcels in the Lower Boise subbasin. While the uniform results produced by Option B simplifies the calculation of baseline for an individual field and is more likely to capture and average out basin-wide variability in crop rotations or land management changes that will occur over time after the baseline obligation has been set, it is less likely to reflect current and site specific loadings for an individual site. As a result of its fixed nature, Option B could also be applied to end-of-drain projects based on the acreage of contributing fields to determine the per acre load reduction associated with that acreage.

  Although both approaches would provide a consistent method for calculating baseline obligations, the fixed nature of Option B would afford more predictability across projects to buyers and sellers of credits because the per acre obligation would be known at the planning, recruitment, and implementation stage. For municipal buyers in particular, having the ability to monetize the impact of baseline at the planning stage would prove helpful when considering trading against other fixed cost technological options.

- **Complexity & transaction costs:**
  The more complex the baseline calculation, the more difficult it will be to execute in practice and the higher the transaction costs for each trade. Compared to Option B, Option A would require more time and resources (for every field, not just those participating in trading and in need of credit calculation, time would be needed to collect the data necessary to run SISL at the site, calculate reduction estimates, review the calculation, work through objections to the calculation, etc.). The field-by-field modeling process associated with Option A would therefore create more transaction costs—both at the field-level for each individual baseline calculation and on the broader scale when proportional shares have to be recalculated each time individual field conditions or crop rotations changes.

  An additional consideration for establishing baseline obligations is whether the required TP load reductions should be applied to each individual tributary or aggregated across all of the tributaries. Applying the TP load reduction requirement to achieve the tributary LA to only the fields within a tributary drainage area would require the complete mapping of drainage paths for all fields within the Lower Boise subbasin. That is, the runoff from each individual field would need to be traced from the edge of the field to a tributary mouth. Given the complex hydrology of the Lower Boise subbasin, accurately capturing the movement of runoff in order to link it to a tributary load, may not be possible.

  Another relevant consideration is how effectively the two approaches would be tracked over time with phased baseline. With a fixed per acre reduction target, the division of the load into different baseline phases to match TMDL implementation phases[16] would be easy to understand and track. For example, using the "all fields, all tributaries" approach from Table 5, 1.21 lbs/acre would be the complete baseline obligation. This value could be easily divided into halves or thirds for each phase, and it would be easy to determine whether the calculation had been performed properly and to identify the baseline phase during which a project was implemented. With Option A, this same type of division could occur, but the division would be of the field-specific proportional load, meaning that all sites would have different proportional shares in different phases. This could make tracking more difficult over time.

- **Outcomes:** Option A would be more equitable at the field level in that the proportional impact of a field affects the relative stringency of the baseline obligation at that field. Option B would not be tied to the specific circumstances at a field, and so could result in baseline obligations that are higher or lower than the proportional impact of the field. While Option A is more equitably linked to the current impact from an individual field, the approach may provide less incentive to undertake improvements on the fields with largest loading contributions, as these sites have the highest proportional impact and would have the highest baseline obligation. Conversely, Option B has the potential to incentivize project developers to choose the highest impact projects right away, which could help lead to larger pollutant reductions more quickly.

[16] As the Lower Boise River TMDL states: "The targets established for point and nonpoint sources in this TMDL may take decades to be achieved… This TMDL does not define an implementation time frame for nonpoint sources; rather, implementation would begin as quickly as possible and continue until the load allocation targets are met. This acknowledges that successfully achieving the TMDL target and allocations will depend in part on voluntary measures and be influenced by available funding, cost-sharing, willing partners, and opportunities for water quality trading." Idaho Dep't of Envtl. Quality, Lower Boise River TMDL: Final 2015 Total Phosphorus Addendum, at § 5.5.1 (Aug. 2015). Accordingly, the TMDL relies on a staged implementation strategy as referenced in EPA's phased TMDL clarification memo. U.S. EPA, Memorandum from Benita Best-Wong to Water Division Directors re: Clarification regarding "Phased" Total Maximum Daily Loads (Aug. 2, 2006), *available at* https://www.epa.gov/sites/production/files/2015-10/documents/2006_08_08_tmdl_tmdl_clarification_letter.pdf.

- **Alignment with regulatory precedent:** Another important consideration is regulatory precedent for baseline calculation methods. Baseline calculations similar to Option B have been utilized and have received support from EPA in implementation of the Chesapeake Bay TMDL. The Chesapeake Bay TMDL, widely considered the most robust nutrient TMDL in the nation, allows for nutrient credit trading as a method states may use to achieve compliance with the CWA. As such, it serves as a useful example to guide the baseline discussion in other water quality trading programs. The Chesapeake Bay TMDL states that nonpoint source baseline must be "consistent with the TMDL LA for the appropriate sector and may be further defined in terms of load, geographic scale, minimum practices, schedule of implementation and/or time needed to facilitate improved environmental compliance with the WQS."[17] Several Chesapeake Bay states have formed trading programs.[18] EPA has provided feedback to each of those jurisdictions on their trading programs.[19]

  The approach employed by Maryland uses modeling to translate the goals for each tributary (from the TMDL's LAs or the local TMDL implementation plans) into baseline for individual parcels. The load allocations for each tributary are first divided among the various land uses. The load allocations for agricultural are then further divided between crop, hay, and pasture land uses. Lastly, the tributary-scale allocations for each of those agricultural land uses is allocated based on the number of acres in the region dedicated to that land use. This produces a per-acre baseline for all farm acreage in the basin currently engaged in that specific land use. Using this information, individual baseline obligations can be determined based on the acreage and land use for specific farms. Achieving these baseline requirements may also require the implementation additional of BMPs, depending on an individual tributary's implementation plan. Although the other jurisdictions pursued practice-based baselines, which appear simpler at first blush, Maryland opted for a field-level, load-based system derived from the TMDL allocations, which took more initial effort to formulate but may be better able to withstand scrutiny.[20] So long as current nutrient loading, as determined by existing conditions on the parcel, is below the assigned baseline, that entity may start generating credits without having to implement additional practices as a prerequisite to participation. This method minimizes the transactional costs for individual projects. In its review of Bay programs, EPA did not determine that the approach chosen by Maryland was inconsistent with the Agency's policy on deriving project baselines.[21]

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[17] U.S. EPA, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment, at App. S-3 (Dec. 2010), *available at* https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-tmdl-document.

[18] Maryland, Pennsylvania, Virginia, and West Virginia all have currently active nutrient trading programs.

[19] EPA, EPA Evaluations of Trading and Offset Programs in the Chesapeake Bay Watershed, https://www.epa.gov/chesapeake-bay-tmdl/epa-evaluations-trading-and-offset-programs-chesapeake-bay-watershed.

[20] Compare Maryland's field-based load approach with Pennsylvania's approach, which requires the implementation of one of three BMPs and 10% credit retirement. U.S. EPA, Final Report, Pennsylvania's Trading and Offset Programs Review by Observations, 6-10 (Feb. 17, 2012), *available at* https://www.epa.gov/sites/production/files/2015-07/documents/pafinalreport.pdf. EPA scrutinized the assumptions underlying this approach.

[21] U.S. EPA, Final Report, Maryland's Trading and Offset Programs Review by Observations (Feb. 17, 2012), *available at* https://www.epa.gov/sites/production/files/2015-07/documents/mdfinalreport.pdf.